NATIONAL TRANSPORTATION SAFETY BOARD

IN RE:	
THE EL FARO INCIDENT OFF THE COAST OF THE BAHAMAS ON OCTOBER 1, 2015	NTSB Accident No. DCA16MM001

INTERVIEW OF: DR. RICK KNABB
DR. ED RAPPAPORT

Wednesday,
October 14, 2015

USCG Seventh District Command Center
Miami, Florida

BEFORE:

JON FURUKAWA, NTSB
DENNIS BRYSON, ABS
PATTY FINSTERBUSCH, TOTE Services
PAUL WEBB, U.S. Coast Guard

PRESENT ON BEHALF OF THE INTERVIEWEE:

CDR [redacted] U.S. Coast Guard JAG Corps

This transcript was produced from audio provided by the National Transportation Safety Board.

TABLE OF CORRECTIONS TO TRANSCRIPT OF INTERVIEW FOR

The El Faro incident off the coast of the Bahamas on October 1, 2015

TAKEN ON

October 14, 2015

PAGE NUMBER	LINE NUMBER	CURRENT WORDING	CORRECTED WORDING
2	23	handout that generated	handout that I generated
3	23	pictures	picture
4	16	to the right. That says	to the right that says
4	20	time advisory	time of the advisory
6	8	is	are
7	17	left for it's days 1	left for days 1
7	24	fo	of
8	8	storm be	storm could be
8	12	store	storm
8	20	kind of over each other	kind of covers each other
9	11	at	as
9	15	and moves	to move
10	1	marine community is both	marine community, is both
10	25	plotted online the 24 hours forecast.	plotted the 24-hour forecast.
11	10-11	tropical analysis and forecast branch	Tropical Analysis and Forecast Branch
12	15	TATH B (phonetic) Unit	TAF-B (phonetic) [for Tropical Analysis and Forecast Branch] unit
12	20	correspond to that.	correspond to that. [Addendum from Rappaport: significant wave height is the mean height of the highest 1/3 of waves]
12	23	suggest	suggests
13	20	TATH B	TAFB
14	12	first one and we	first one [graphical product] and we
14	21-22	TATH B, the tropical analysis – the forecast branch	TAFB, the Tropical Analysis and Forecasts Branch
14	23	38	30
14	24	north	North
15	16	off-shore water zones that TATH B	Offshore Waters zones that TAFB
16	19	To	Too
17	9	THAT B	TAFB
22	22	or	of
23	22	It swells.	The swells.
24	23	is the current	is current
26	4	extent	extend

27	20	from new source	from a new source
28	8	TATH B	TAFB
32	1	how it races up the wind	how it (?) up the wind
33	19	we didn't it moving	we didn't forecast it moving
34	23-24	strengthened more and more quickly	strengthened more, and more quickly,
40	8	TATH B	TAFB
40	22	store	storm
45	11	SMFR still frequency radiometer	SFMR, stepped-frequency microwave radiometer
48	8	can get drops on data	can get dropsonde data

If, to the best of your knowledge, no corrections are needed kindly circle the statement "no corrections needed" and initial in the space provided.

NO CORRECTIONS NEED. _____
Initials

Edward Rappaport

Printed Name of Person providing the above information

[redacted]

Signature of Person providing the above information

November 3, 2015

Date

P-R-O-C-E-E-D-I-N-G-S

(2:24 p.m.)

MR. FURUKAWA: It is Wednesday, the 14th of October, 2015. The time is 1424. We're here at the National Hurricane Service -- or Center.

DR. RAPPAPORT: Center.

MR. FURUKAWA: Center to interview the Director, Rick Knabb and the Deputy Director, Ed Rappaport about Hurricane Joaquin. This is Jon Furukawa. I'm the Group Chairman for the Survival Factors Group. Why don't you --

MS. FINSTERBUSCH: Patty Finsterbusch, Survival Factors Group member.

MR. WEBB: Paul Webb, U.S. Coast Guard, Survival Factors Group.

DR. KNABB: And I'm Dr. Rick Knabb, K-N-A-B-B as in boy, Director here at the National Hurricane Center.

DR. RAPPAPORT: And I'm Ed Rappaport, Deputy Director of the National Hurricane Center.

MR. FURUKAWA: Okay. And so, Ed, Do you want to go and talk to us about Hurricane Joaquin?

DR. RAPPAPORT: Sure. Thank you. What I've provided to each of you is a handout that generated over the last few days, after knowing that you were going to be coming and visiting with us. We learned that this weekend.

And the objective here has been to show the analysis and forecast of the hurricane alongside with the plot of the ship's track. And, in essence, it's to show what information was available at the particular time that we've shown each of these slides.

So, in fact, if there's a -- if there's a time that's 8:00 a.m., what will be shown on the graph is the forecast and analysis that was available at 8:00 a.m. It may well have been issued at 5:00 a.m. or 7:00 a.m. but it would have been out in the public by that time.

I'd also say that the -- consider this to be preliminary in that we put it together rather quickly. There are also a few other features I'd like to add on to it and some double-checking probably needs to occur but I think it should provide a pretty good overall perspective of what was the -- what was forecast and what was available about that forecast at the time that each of these charts is showing.

MR. FURUKAWA: Okay.

DR. RAPPAPORT: So, if we move to the first graphic, maybe we should spend a little extra time on this. There's a lot here, so we know what -- you all understand what we're looking at. The background pictures is the Southwestern Atlantic along with Florida and Cuba and the Bahamas area. And this graphic is one of a few that are

like this that are available routinely on our National Hurricane Center website. We talked about that we issue forecasts extending out five days into the future.

This particular graphic, while we have a five-day graphic that appears on our web page, this particular graphic is the version that shows the first three days of the forecast and there are two reasons for doing that. One is that the fourth and fifth day are beyond the period of our primary interest. The other is that, by limiting it to three days, the chart, itself, is more zoomed in. If we have five days with a longer track, the map would have to be bigger and so all the features on the map would be smaller. So I have used the three day forecast here.

And the -- what is shown on the map that's always here is -- you see there's a little orange circle in the middle of the page to the right. That says 5:00 p.m. Tuesday. What this indicates, this is the position of the -- of the center of the tropical cyclone at that time and also corresponds, as you see across the bottom, to the date and time advisory shown there. So this is the information that was issued by the National Hurricane Center at 5:00 p.m. Eastern Time on Tuesday, September 29th. It was our eighth advisory for the storm.

And we mentioned previously we're on a six-hour cycle. So our first advisory actually occurred at 11:00

p.m. back on Sunday night. And so, if you move yourself forward six hours at a time, this would be our eighth advisory and there are a number of things shown on here.

As mentioned, the second column of information below the actual graphic, you see where the current -- it says, "Current Information." That's where the storm is centered. You see the latitude and the longitude. Also, the maximum sustained wind speed, so there are the winds that we call sustained and there are also gusts that are higher than that. So, at this particular time, the maximum winds were analyzed to be 65 miles per hour and the movement of the storm center was towards the west/southwest at 5 miles per hour.

Then, also shown are -- is some forecast information and, if you look, attached to that orange circle you'll see a line extending towards the west/southwest to a -- to a black dot that has an S in the middle of it. Everybody see that there? That is the 12-hour forecast for where the center of the storm will be and the intensity of the storm, not to -- not like miles per hour but like status in terms of a tropical storm or hurricane or tropical depression. And, here, an S represents tropical storm.

So what you see then is that the storm had 65-mile-an-hour winds at 5:00 p.m. The 12-hour forecast

from that time said -- showed it moving west/southwest and still being a tropical storm at that time.

And, if you advance another 12 hours to the dot that's labeled 2:00 p.m. on Wednesday, you'll see that there's a new position there and there's also an H in the middle of it, so the forecast for that particular time was for it to be a hurricane. And, of course, we can show you later.

The details of these -- of this forecast is available through text products. So the actual wind speed that we were forecasting would be available there. And this is just a shorthand. You see -- going to see quickly that we were forecasting the storm to be here.

So what's shown there then is the 12-hour, 24, 36 and 48-hour forecasts all heading towards the southwest or west/southwest and then one more position that's up more towards the northwest. After 48 hours, we go to 24-hour intervals, so 12, 24, 36, 48 and then 72 hours. So that other dot there is 72 hours.

MR. WEBB: The last one?

DR. RAPPAPORT: The last one is -- yes. In fact, it's labeled there 2:00 p.m. Friday. You can see the -- there's a label coming off to the --to the left of it -- of that last dot.

Now, you'll notice that it's not exactly 72 hours from the start of 5:00 p.m. Tuesday. That's because,

when we issue a forecast of 24 hours from 5:00 p.m. it actually goes to 2:00 p.m. the next day. It's actually 21 hours later. The analysis was made back at 2:00 p.m. but, by the time the forecast got out, now it was 5:00 p.m, so the forecast was for 2:00 p.m. the next day, 24 hours later. And that pulls all the way through.

So, while this particular -- all of our products came out at 5:00 p.m., they're based on 2:00 p.m. information and, therefore, the 2:00 p.m., 2:00 a.m., 2:00 p.m. for the days that follow. Is that understood then? Okay.

So that's the -- and then the other thing that's on this graphic that's always there is beyond those -- the black dots would show the tropical cycle and position. Remember, it's just the center of the storm. It's a -- you can see in the lower left, potential track area. There's a little icon there at the lower left for it's days 1 through 3.

And what that shows is, if -- it shows an area that bounds or surrounds the center points that we forecast and it's based on -- what -- it gives an indication of the uncertainty of the forecast for the center and, actually, this feature is designed or it's set up to enclose the entire track fo the storm out to that time about two-thirds of the time.

So, in other words, in this white area here, the little tear drop in this particular case, indicates that from 5:00 p.m. Tuesday, given that forecast, two-thirds of the time the center will remain within that area. And there's about a third -- 33 percent chance that it could venture out at some point. So it gives a kind of a indication of the confidence level that you have in terms of how far away the storm be from what we're actually forecasting.

I think we'll get a better feel for it when the pattern elongates a little bit. The reason why it's almost circular here is that the store is moving only very slowly. So the uncertainty and the center position don't change very much. If you had the storm moving quickly, like this, you get more of like a tear drop or cone around the center. There's uncertainty associated with each of those positions as we move further along in time.

MR. WEBB: Right. That makes sense.

DR. RAPPAPORT: But it kind of over each other -- they plot over each other in some ways here.

MR. WEBB: When a storm moves slowly like this, do they become stronger or is it -- I mean do they build more power around them?

DR. RAPPAPORT: It can. It can. Often, in fact, they don't though.

MR. WEBB: Do they fall apart?

DR. RAPPAPORT: In some places, not usually here, the -- when a storm is stationary or nearly so, it's winds actually stir up the water underneath it bringing up -- up-welling cooler water and actually put a limit or a break -- limit or a break on the intensity of the storm. So it has a feedback on itself.

But, in cases like the southwest Bahamas and the Carribean sea, the warm waters are so deep that, when you stir them up, you're still bringing up almost as warm water, which serves at the fuel for the storms.

MR. FURUKAWA: Oh, I just learned something.

DR. RAPPAPORT: So looking from the general view of what we have here, we have a tropical storm that's forecast over the next two to three days and moves slowly towards the west/southwest and to strengthen to become a hurricane. And I should say that this is the first advisory, 5:00 p.m., Advisory 8, where the forecast was for the system to become a hurricane. All the previous forecasts were for it to either remain as a tropical depression or become a tropical storm. This is the first time that we introduced forecast -- into the forecast that it would be a hurricane.

A couple of other things to point out here as well, one of the things that's analyzed and it's important

to my understanding for the marine community is both the size of the wind field and the size or the extent of significant waves of a certain height. And the threshold that we use in our analysis and forecast is 12 feet.

So what we've got plotted here, centered on that first H are -- is a semicircle, let's see, directed towards the northeast and a semicircle directed towards the southwest. For those who are having trouble seeing it, I'm talking about this semicircle here and this little one down here to he southwest.

From this forecast time, this is what the area of at least 12-foot waves is forecast to be 24 hours later. So I've centered it on the point that corresponds to 24 hours later, where it's the first time it's a hurricane. And that then is, from there, the area that it's forecast to have at least -- to have seas that are at least 12 feet. So, in other words, at this time, the forecast is for the area towards -- northeast of the storm to -- for the -- those 12-foot seas to extend further out than they are shown to the southwest of the storm.

MR. FURUKAWA: Okay.

DR. RAPPAPORT: Is everything okay so far? So, then, on this one particular graphic, because we're actually more than a day away from when the series of problems began, I plotted online the 24 hours forecast.

But we also have a forecast 48 hours ahead of what those seas -- of what the size, the radial extent of those seas. And so from -- what you'll see on this for them is, if you go all the way to the last H before it turns back northward to this particular H, that's the 48-hour point from -- the 48-hour forecast point for the forecast to be a hurricane at that time.

And you'll see two little bubbles there. One's in the northeast and one to the southwest. Those -- that, again, indicates from our tropical analysis and forecast branch the area of -- aerial extent of 12-foot seas at that time, 12-foot or higher seas at that time. So, in essence, the outer ring there around them would be the contour indicating when you reach 12-foot seas.

DR. KNABB: Again, I think it's important to emphasize here that the -- those orange-shaded areas are examples of where those seas would occur if that forecast point was exactly correct.

DR. RAPPAPORT: Right. And, if the size of the forecast -- size of the radius -- radii that we're looking at is correct as well. It could be a lot bigger. It could be smaller and it could be centered in a somewhat different location if the forecast for where we think the center will be is different.

DR. KNABB: But, as the cone around it

indicates, we are trying to convey on this graphic where the center could potentially be all the way out to three days.

DR. RAPPAPORT: Right. So looking at the -- at the words for each of those, you can see on the upper right it says, "12 to 24-foot seas for Wednesday, September 30th at 2:00 p.m. from the 24-hour forecast at September 29th, 5:00 p.m." Remember this is -- this particular graphic is current at 5:00 p.m. on September 29th. Moving forward 24 hours, which is not exactly 24 because of the way we do it, it would be 2:00 p.m. on September 30th and so you see where the forecast is for 12-foot seas -- extended 12-foot seas. And the same thing as you go to 48 hours.

The maximum there -- you'll see that it says 12 to 24 feet, our TATH B (phonetic) Unit not only forecasts the extent of the 12-foot seas but gives a forecast for what the maximum sea height, significant wave height would be within that area. And I believe the significant wave height is -- we need to check this but the tallest two-thirds of the waves correspond to that. There can be occasional ones higher than that, obviously.

So, at this first time, the 24-hour forecast suggest that that area will enclose -- encompasses seas of 12 to 24 feet. By the 48-hour forecast, you can see that they've increased the maximum possible wave height to 28

feet. So, we look at what this means. If this was -- if this is correct, then the storm center will be located here just south of 25 North at 48 hours. It'll be a hurricane and there will be 12 to 28-foot seas extending out into that orange bubble. That's where the worst of the seas would be. Okay?

DR. KNABB: Again, it's important to emphasize the orange areas Ed has superimposed manually on top of this.

DR. RAPPAPORT: Right.

DR. KNABB: This is now the way the graphic would have appeared. It would not have had those orange areas. The orange areas are based upon the text forecasts.

DR. RAPPAPORT: Right. All this information is available but I've now combined it to have a summary chart here with what we think might be the -- some useful information for you.

DR. KNABB: And, again, can't emphasize enough how important it is to remember that those seas are forecast by TATH B to occur relative to where the center is at that time. But we never guarantee with 100 percent certainty that that is where the center of the cyclone is going to be --

DR. RAPPAPORT: Right.

DR. KNABB: -- at 48 hours. And that's the

purpose of the cone around there, to show you the potential track area.

DR. RAPPAPORT: The wide area, right.

DR. KNABB: Yeah.

DR. RAPPAPORT: And, again, the reason we chose this time is, if you look, this is the ship location as you've indicated to me as of 8:00 p.m. on Tuesday, the 29th. So the valid forecast at that time would have come out at 5:00 p.m. on that day. Forecasts come out at 5:00 p.m., 11:00 p.m., 5:00 a.m., 11:00 a.m. Okay? Unless there's a special advisory that requires an update.

So that's the very first one and we won't need to spend as much time on all the others but I wanted to make sure we all had a pretty good understanding. Is there anything that I should explain further or clarify?

MR. WEBB: No.

DR. RAPPAPORT: Any questions on this one? Okay.

Now, the second graph is identical to it but what I -- with one exception. And, here, I superimposed the marine hurricane warning area. So the TATH B, the tropical analysis -- the forecast branch puts -- issues forecasts for all of the area of the Atlantic south of 38 degrees/31 degrees north to -- down to the equator. But they also subdivide that into different zones. And this

is the particular zone of -- this is a zone of interest to us and, at this particular time, there was a marine -- there was a hurricane warning in place for this zone. So, if you went to the text products that they issue, it says, "Hurricane Warning," and then it describes --

MR. WEBB: Right.

DR. RAPPAPORT: -- other factors at the time -- at that time. And, in this case, this was the only -- the only area associated with the storm where there was a marine hurricane warning at this particular time. Again, this was the first time that the forecasters had actually forecast it to become a hurricane.

And this additional polygon I put on there to show the marine hurricane warning actually came from this next graphic, which shows a portion of the so-called off-shore water zones that TATH B forecast for. Remember, I said there were -- there were subsets. So there were -- it's subdivided into a number of different areas and this particular time corresponds with the one we've been looking at. This Zone AMZ119, which is touching on the Bahamas and then northeastward, there -- that shows the hurricane warning we just saw on the previous page. Okay?

I did not -- and, to the east of that, you see there was also a tropical storm warning in effect but I did not plot that on our previous draft, just the hurricane

warning. So this polygon area that's shaded in is represented on the page before by just the outline of it. If I put shading there, it would have complicated things so much more, several different colors. So -- and, again, this warning was valid at 8:00 p.m. on the 29th. So, when the ship was departing, this is the information that would have been available.

Now, I moved forward to the next time that we had some information. And we -- these positions and times were just taken from the -- from the web, from one of the marine websites -- ship-tracking websites.

MR. WEBB: Yes.

DR. RAPPAPORT: And so, to the extent that this is correct, this is what I've plotted. So, about five hours later, after leaving port, we have a position which we saw as there at 12:50 a.m. just off the coast of Florida, now, the morning of Wednesday, September 30th.

And with that ship position or that time, what was available at that time to -- publicly at 12:50 a.m. on September 30th, well, the most recent advisory package would have been then the 11:00 p.m. advisory just before midnight. Remember, we're doing 5:00 a.m., 5:00 p.m. -- or 5:00 a.m., 11:00 a.m., 5:00 p.m., 11:00 p.m. So the forecast has changed somewhat now because it's now the next six-hour cycle.

And, while the forecast has changed, the overall pattern and threats and risks and so forth haven't changed a lot. What has happened though, in this period, is that -- two things that you can see on here. One is that there's a zone now to the southwest of the one we saw previously and the zone covers all the Bahamas. That's the zone you'll -- you can see on the next chart, actually. It's labeled "117." That is also now your marine hurricane warning as issued by TATH B.

You also see that there are some islands there just below the word "Bahamas" that are shaded in pink. Can you see that on the -- on the previous --

MS. FINSTERBUSCH: Yes.

DR. RAPPAPORT: I think it was on the previous page.

MR. FURUKAWA: Yes.

DR. RAPPAPORT: Yes. That's where the -- that indicates that the central -- that the Bahamas has issued a hurricane watch, if you look at the legend down below, for the central Bahamas. So, as of this time, there's a marine hurricane warning surrounding where the storm is now on the targeted forecast, ahead of it, and there's a hurricane watch up for the central Bahamas. Okay?

DR. KNABB: It's important to emphasize again that the Bahamas, as do nearly all of the other countries

in our area of responsibility -- they issue their own watches and warnings. So we did not issue the hurricane watch for the central Bahamas, the land areas. Their meteorological service did but we certainly were in communication with them to give them guidance.

MS. FINSTERBUSCH: Right.

DR. KNABB: But we issued the marine warnings.

MR. FURUKAWA: So they don't issue -- like on television or radio, they don't do broadcasts -- marine broadcasts of their warnings?

DR. KNABB: Well, each country disseminates their watches and warnings in their own ways.

MR. FURUKAWA: How does the Bahamas --

DR. RAPPAPORT: Again, these are for land areas.

DR. KNABB: Yeah.

MR. FURUKAWA: Okay.

DR. RAPPAPORT: And the radii may well have changed a little bit from the last time the forecast -- in this case, I didn't put the 48-hour forecast for radius of winds. You still see the 72-hour forecast, which is a little -- which is new now, and the 24-hour forecast for wind radius because 48-hours is now too late. It's gone past the time of when the incident occurred.

So here you can see again, to the northeast,

there's a greater extent than forecast to the southwest but you can see now that a 12-foot seas radius to the southwest is almost impinging. In 24 hours, it would be -- it's forecast to almost be impinging on the northernmost central Bahamas. I think that's Rum Cay there or it's either that or -- yeah, I think it might be. So that's the situation about five hours after it left port.

Should I continue in this way then?

MS. FINSTERBUSCH: Yeah.

MR. FURUKAWA: Sure.

DR. RAPPAPORT: Okay. So now that was 12:50 a.m. Let's advance to the next time that we have anyway, which was 9:32 a.m. Here you can see the plot of the ship where -- from what we saw from the web. And you see that there are still marine hurricane warnings up for the two areas.

MS. FINSTERBUSCH: Do you have this on yours?

DR. RAPPAPORT: Oh, you -- you've gone one ahead. You're up to 1:00. We're still back on 9/8, 9:30 a.m. Go back one more.

So you can see there's -- we've got hurricane -- marine hurricane warnings for the area within the light red lines. The Bahamas has changed their hurricane watch to a hurricane warning. That's the red around the islands. They've issued a hurricane watch for the northwestern

Bahamas. You can see the pink now. It's up in the -- further to the left and up, the northwestern most Bahamas. And you see where the storm is located and our 72-hour forecast: 12, 24, 36, 48 and 72 hours. So the forecast is -- at this point, is for it to move generally towards the west -- maybe west/southwest in the first 36 hours and then turn towards the north and the -- and start to accelerate towards the northeast by 72 hours.

And the 24-hour forecast from this time -- you can see the second dot. That's the 24-hour forecast right above the second A in Bahamas. It's forecast for it to be a hurricane and the radii associated with that 24-hour forecast are shown there and you can see that the 12-foot seas radii extend out quite a large ways to the north and a smaller extent to the south. But pretty much everywhere between the storm and the Bahamas now is forecast to have -- in fact it is. It's forecast to have seas between 12 and 27 feet by 24 hours from this time.

All right. And I also should mention that the -- that the first time with the orange circle is the time of this advisory. It's actually at 8:00 a.m. This is one of our intermediate -- our middle advisories. We -- it is 75 miles an hour, so it is a hurricane at this time.

So, from the broad view, we have now a 75-mile-per-hour hurricane forecast to move slowly towards

the west, in general, or west/southwest for the next 36 hours or so. If you have the text products, you would see that we were forecasting the strength of the winds to increase. We still show just hurricane but the winds were forecast to be stronger than 75 miles per hour and that the area between the storm along its track and the islands, the Bahamas, are all under a marine hurricane -- well, no. They're all under -- they're all within the 12 to 20-foot seas -- 27-foot seas, shaded area there.

So, at 9:30 in the morning, this is what would have been available or was available for the ship if they were looking at our forecast products. The part after that just shows, again, the off-shore zones, which are labeled on the previous chart as a hurricane warning, these two and these two.

Okay. So, if we move forward now to -- it's 9:30 a.m. If we move forward another four hours to -- now we're looking at 1:45 p.m. on the 30th and this chart does not show the marine hurricane warnings only because I didn't have time before you arrived to put them on there. But you can see them -- you can't see the line up but you can see on the page that follows where they really were, in effect. I just couldn't plot them on the same chart but they were still in effect for the same area, the hurricane warnings, marine warnings.

Now, the storm or the ship is -- looks like just to the north of the northwestern Bahamas. The storm is forecast to continue moving west/southwest to west for the first 36 hours or so. It's closing in on the central Bahamas there. You can see the area that's forecast with -- for the next -- at 24 hours from this time to have 12 to 28-foot seas. So this time is -- actually, this would be valid at 8:00 a.m. on October 1st.

Okay. And, again, it's 80 miles per hour. We were forecasting it stronger but to map it we can't see the details of that on this particular chart. We can get you information if you want. So I think that's the main change at this time.

Move forward. Okay. So now we move forward to -- we have two ship positions being received that are very close to each other in time, 6:37 p.m. and 7:42 p.m. I plotted them both. The advisory that would be applicable at that time is the same one though. It's the 5:00 p.m. advisory would be -- would apply in both cases. You can see the two positions for the ship.

And now, rather than showing the 24-hour forecast or the extent of the 12-foot and higher sees, I'm showing what it actually is in our products, the analysis at the current time. So this pattern is no longer centered on the 24-hour forecast. It's centered on right now and

this is what we're showing right now in our forecast products.

MR. WEBB: So he would have the seas and the winds would be coming at him from the east?

DR. RAPPAPORT: Probably north.

MR. WEBB: East/northeast?

DR. RAPPAPORT: Well, the storm center is well to the -- to the east/southeast of that. So assuming circular and maybe inward a little bit I would think from the north maybe.

DR. KNABB: In terms of the winds, but --

DR. RAPPAPORT: Yeah.

DR. KNABB: -- the waves can propagate outward.

DR. RAPPAPORT: The waves. Yes. Right. The winds would have been coming probably from the north but the waves would have been propagating --

MR. WEBB: Coming from like -- more like the south.

DR. KNABB: Well, you'd have -- you'd have a combination of, you know, wind-generated waves at the location but, also --

DR. RAPPAPORT: It swells.

DR. KNABB: -- large --

MR. WEBB: A big swell.

DR. KNABB: -- longer-period swell would have

propagated out from the hurricane --

MR. FURUKAWA: You gave height of the swell, too, or just the sea waves?

DR. RAPPAPORT: Well, it's a significant wave. I'm don't know what the -- I'm not sure how they --

DR. KNABB: Well, they -- they're forecasting the seas and it's not just the wind wave and it's not just the swell.

MR. FURUKAWA: It's a combination?

DR. KNABB: Yeah, the products will often say, you know, seas -- you know, winds northeast 20 knots. Seas to 8 feet and a swell to 12 feet. If it's a confused situation where wind, waves and swells can be approximated, they might split it up.

MR. WEBB: Okay.

DR. KNABB: But they're -- but, again, they're primarily conveying a significant wave height and that's what the warnings are heavily based on.

DR. RAPPAPORT: Yeah. So, at this time now, we're talking about 5:00 p.m. -- the 5:00 p.m. advisory, most recent available to the ship. The maximum winds were 85 miles per hour, again, very near the center. And what I've plotted here is the current as of 5:00 p.m., radii of 12 to 27-foot seas. That's analyzed by the Hurricane Center. And, if you look at that, the ship is still outside

the 12-foot seas -- the extent of the 12-foot seas. But those 12 to 27-foot seas, if you look ahead, extend all the way from the storm to the Bahamas at this time, so in front of the ship. Does that make sense for everyone?

MS. FINSTERBUSCH: Yes.

DR. RAPPAPORT: Okay. And there's still the -- if you look on the next page, the marine hurricane warning, of course, is still in effect. So that was as of -- at 7:42 p.m. The next one is 12:01 a.m. that we saw from the web. And here now you see the winds have increased significantly. The maximum winds -- sustained winds are estimated to be 115 miles per hour. That would be very near the center of the storm.

And, in fact, do you see the little red contour that's pointed to by the red arrowhead?

MS. FINSTERBUSCH: Yes.

DR. RAPPAPORT: That's actually the extent of hurricane-force winds. All the hurricane-force winds are within that contour and they get as high as 115 miles per hour. But you can see the extent of hurricane-force winds from the center. It's very small. It's only between 20 and 30 miles.

MR. WEBB: And then inside that's the eye?

DR. RAPPAPORT: Inside that would be the eye wall and the eye. Right. So you have the eye, the eye wall

around it with the strongest winds, and then if you go out to about 20 or 30 miles, you reach the outer limit of the 64-knot hurricane-force winds. Tropical-storm force will extent out significantly further but I -- one of the observations here is how small, relatively speaking, that is.

And so he was well outside of hurricane-force winds at this time. There may have been gusts to hurricane force. There may have been strong tropical-storm force. But they weren't at 64 knots, based on analysis, which would have included the data from the reconnaissance aircraft, I believe. That would have been part of it.

So the winds are likely of tropical-storm force at that stage and he's just inside the 12-foot seas contour. So, at midnight, just a little bit inside that 12 to 30-foot contour with the 12 being most likely on the outer part and the 30-foot closer in towards the center of the storm.

MR. WEBB: So he would -- he'd probably have about 12-footers then where he was at?

DR. RAPPAPORT: If this was right, it would be maybe a little higher than 12-foot.

MR. WEBB: Okay.

DR. RAPPAPORT: Yeah.

MR. WEBB: About 15 foot?

DR. RAPPAPORT: Perhaps. We don't have a

15-foot analysis but that would be if you interpolate between --

MR. WEBB: Yeah. Right.

DR. RAPPAPORT: -- that and the center, you're probably looking at something like that. But he's now only -- you know, he's not very far away from the center of the storm but doesn't have hurricane-force winds because it's such a small area around the center. So, as he progresses towards the east/southeast and the storm is moving slowly towards the west/southwest, the two are closing in on each other.

But the path between where he would want to go in the Bahamas is covered by, you can see, a 12 and 20 -- two dots to the left there and they're both M. It was forecast for a major hurricane which is at least a hundred knots. So winds aren't hurricane force there yet but we're forecasting them to become extreme there. Okay?

MR. WEBB: Yep.

DR. RAPPAPORT: And the last one is a position that we got from new source. I don't know how accurate it is. It's from Reuters. And I plotted that. So this is 3:56 a.m. So it's only moved ahead four hours.

MR. WEBB: Okay.

DR. RAPPAPORT: It went ahead four hours and, where we -- you can see here where we got this space between

them -- the center of the storm and the ship at the previous time with the ship moving towards the southeast and the storm moving slowly towards the west/southwest -- or southwest, they closed in on each other just in that four-hour period. He -- it's now just about reaching the hurricane force -- sustained force -- hurricane sustained-force winds but well inside the 12-foot seas area and, in fact, the TATH B forecast is -- well, the analysis is for this to be 12 to 30-foot seas within that area. So --

MR. WEBB: So he -- where he's at there at 4:00 a.m., he's probably closer to the 30-foot seas?

DR. RAPPAPORT: Yes, because that ring around it that you see is just outside the eye wall, which would have the hundred-knot winds.

MR. WEBB: Right.

DR. RAPPAPORT: That's the 64-knot in contour but those seas would have been, as you said, probably I would say approaching the maximum. I think that's the last one on the offshore corresponding marine hurricane winds. So --

MR. WEBB: So it looks like, if -- so this thing is still going to head kind of west --

DR. RAPPAPORT: Right.

MR. WEBB: -- and to the north. So, if the ship

was there and it's disabled at some point, the eye -- it looks like it went right over the ship.

DR. RAPPAPORT: And, in fact, if you notice the -- that's his position at 4:00 -- roughly 4:00 a.m., 3:56 a.m.

MR. WEBB: Okay.

DR. RAPPAPORT: This contour of 64-knot winds is around the storm position at 2:00 a.m. So, if you move forward two more hours, the storm would have moved another 5 or 10 miles towards the west/southwest. It's actually even a little bit closer, not much that you can see here, but it's a little bit closer to the -- to the ship at that time. So the two are really moving towards each other.

So things -- if you -- based on this, the conditions deteriorated very rapidly after this last observation at midnight. Before midnight would have been in seas under -- probably under 12 feet and winds well under hurricane force but it all changed in that -- in the four hours that followed.

MS. FINSTERBUSCH: And that's when they lose this battle.

MR. WEBB: And when did they make that call that the third mate was still on the bridge?

MS. FINSTERBUSCH: Third mate was still on the -- she sent the email to her mother after she finished the

12:00 to 4:00 watch, so between 4:00 and 5:00.

MR. WEBB: And --

MS. FINSTERBUSCH: And she knew she -- they were heading into a Cat 3 storm. And she was prepare -- but she didn't seem worried about it. You know, it wasn't like pray for me and stuff. It was just, you know, heading into a Cat 3 storm, you know, and we're on our way.

But even -- I can get Jon's message out but here's what the -- just tell me what you're -- what you think. This is the Captain on September 30th at 1:00 in the afternoon. Okay? So --

MR. WEBB: (Inaudible.)

MR. FURUKAWA: Yes. We have 1:45 p.m.

MS. FINSTERBUSCH: All right. "Per the latest BBS weather file and National Weather Center, Hurricane Center, Miami, Florida. The center of the Hurricane Joaquin is 24.7 North, 72.6 West."

MR. FURUKAWA: Yeah. That's about where the orange circle is.

MS. FINSTERBUSCH: "Direction of" -- "Direction speed: southwesterly at 5 knots."

MR. FURUKAWA: Yep.

MS. FINSTERBUSCH: "Barometric pressure is 971. Winds 50 knots with gusts up to 70. Seas 12 to 4 throughout the night and into tomorrow morning are

expected."

MR. FURUKAWA: There's something that's --

DR. KNABB: Yeah. The 50 knots up to 70 is not --

MR. FURUKAWA: That's not correct.

DR. KNABB: That's not high enough.

MR. FURUKAWA: It's actually 70 knots.

DR. KNABB: Yeah.

DR. RAPPAPORT: The location was right or was the same as ours and the movement was the same as ours but the -- by then it was already a hurricane with 70-knot winds.

MS. FINSTERBUSCH: Okay.

DR. RAPPAPORT: Okay.

MS. FINSTERBUSCH: "I have monitored Hurricane Joaquin's tracking erratically for the better part of a week. Sometime after 9:30 she began her southwesterly track. Early this morning, I adjusted our direct route into a more south/southeasterly direction towards San Juan, which will put us 65 plus or minus nautical miles south of the eye.

DR. RAPPAPORT: So, if that had occurred, they would have -- he would have experienced less-than-hurricane-force sustained winds but seas well above 12 feet. It would have been still within the 12 to

28-foot sea forecast area. So I'm not sure how it races up the wind speed but that -- because it had -- it had been a hurricane since -- it was 55 knots when he left port and --

DR. KNABB: But forecast to become a hurricane by winds --

DR. RAPPAPORT: Forecast to become a hurricane and then five hours later it was 60 knots and then it was 65 knots at 9:00 in the morning. So it was a hurricane at 9:30 in the morning -- or at -- actually, at 8:00 in the morning.

MS. FINSTERBUSCH: What category were you figuring this hurricane was going to be? Do you -- I mean that's what it would say on the news. So --

DR. KNABB: Well --

DR. RAPPAPORT: Yeah.

DR. KNABB: All right. The graphics that Ed is showing will depict from our forecast whether or not we're forecasting it to be a hurricane or a major hurricane. When we're forecasting a major hurricane on the Saffir-Simpson hurricane wind scale a Category 3 or stronger, then you'll see an M denoted by the dots.

The initial forecast that is in this set from 5:00 p.m. on the 29th shows it not becoming a major hurricane in the first three days. I believe the first forecast to explicitly forecast a major hurricane was the

one issued on Wednesday afternoon.

MS. FINSTERBUSCH: Yeah. September 30th at --

DR. KNABB: At 5:00 p.m.

MS. FINSTERBUSCH: Yeah.

DR. KNABB: All right. And it became a major hurricane sooner than forecast?

DR. RAPPAPORT: Yes. It --

DR. KNABB: And it rapidly intensified over that night.

DR. RAPPAPORT: The hurricane intensified more rapidly and more in total than we had forecast early on. We had forecast it to be a hurricane and have the seas but we didn't forecast the -- there the other part to have the winds as strong as they got to.

MS. FINSTERBUSCH: Did you think it was going to sit there but move as slowly as she did?

DR. KNABB: Generally speaking, yes.

DR. RAPPAPORT: Yeah. If you look at some of our forecast, we didn't it moving very much at all, very slowly.

DR. KNABB: Yeah. Even the forecast graphics from 5:00 p.m. on the 29th -- that motion toward the southwest was pretty slow by historical standards. It's slower than your average forward motion.

DR. RAPPAPORT: Yes. Looking at this, again

this first look, the ship didn't get to hurricane-force winds until basically the last report that you had and the strong winds, whether they're major hurricane or not, they've all been still ahead a little bit. So it was still approaching hurricane-force winds. I think the -- even though the intense -- the inner part strengthened much more, the hurricane-force winds were still only about 20 or 30 miles from the center of the storm.

What most likely was significant was that, as the winds were increasing, they were generating higher and higher waves, which were not confined to that ring -- that small ring around the center but were propagating outward.

DR. KNABB: Yeah. The waves are not just a direct result of the winds occurring at that spot. You know, the waves are going to be larger the longer period of time they blow in a particular direction, the longer distance over which they blow and the -- and the increasing strength of the wind speed. So the longer the hurricane's -- hurricane was slowly moving in this general area, the greater the seas were becoming farther and farther out from the hurricane.

DR. RAPPAPORT: So, in a direct sense, the hurricane forecast -- the hurricane strengthened more and more quickly than forecast. But, based on this, they didn't even -- they didn't reach hurricane-force winds

until right at the last report. But the swells, the waves they would have gotten because it was increasing so much in terms of strength would have been -- would have already reached them, the higher -- the larger waves.

DR. KNABB: And the waves that had been generated even prior to that, the wave energy generated prior to that would have begun affecting them well before that.

DR. RAPPAPORT: Right, even when -- right. At this time, at 12:00 a.m., it's now a major hurricane, 100 knots or 115 miles per hour. But they would have been receiving the waves generated by it when it was a hurricane but not that strong, not as strong of a hurricane when it was 65 knots and 70 knots and 75 knots, before it jumped to 100 knots. So -- and that's why the forecast had been for seas to be as high as -- even at that time it was forecast for it to be as high as -- let's see. Was it 30 feet?

MS. FINSTERBUSCH: That's what I've got on this one.

DR. RAPPAPORT: Yeah, 28 to 30 feet.

DR. KNABB: And they first reached the -- actually reached the marine hurricane warning areas on Wednesday afternoon, you know, at 1:45 or 2:00, somewhere in there.

DR. RAPPAPORT: You know, I'll need to --

actually to add that on. I just haven't had a chance to do that yet because the marine hurricane warning area extends from the tip of the northwest Bahamas, basically, to the southeast to Turks and Caicos it looks like. I don't know why originally but the whole area there was under hurricane warning as of 12:00 -- as of 12:50 on Wednesday and much of the area -- all the area to the right. Where the ship's going, to the left was under hurricane warning at 8:00 p.m. even the night before.

DR. KNABB: On the 29th.

DR. RAPPAPORT: So we have, in fact, when they left, if we go back to the very first time at 8:00 p.m. on the 29th, here it's forecast to become a hurricane. It's not forecast to become a major hurricane. But it's forecast to become a hurricane, move to the west/southwest. By 24 to 48 hours from this time, seas of 12 to 24 feet were going to be between it and the Bahamas, between the storm and the Bahamas and there was, at that time then, a marine hurricane warning issued for that area just to the right of the Bahamas, to the east of the Bahamas.

So, again, the first time that it was forecast to become a hurricane was this first -- the first graph and that's when the hurricane marine warning went out. And you can see where the 12-foot seas and higher were forecast to be.

MS. FINSTERBUSCH: But he would have expected to have been in Puerto Rico for Friday morning or Thursday night -- Thursday night. So --

DR. RAPPAPORT: Right. Well, this was 2:00 p.m. on Thursday. So it's a -- running southwest.

MS. FINSTERBUSCH: Yeah. There's Wednesday and the he would have -- he figured he would -- he was going to be past there before it got into that Thursday/Friday because he should have been passed it by Thursday.

DR. RAPPAPORT: Let's see.

MS. FINSTERBUSCH: When did it start? I'm losing my dates again.

DR. RAPPAPORT: Yeah.

MR. FURUKAWA: When did the transit start?

MS. FINSTERBUSCH: It started on --

DR. KNABB: Tuesday evening? No?

MS. FINSTERBUSCH: They're in -- they're in -- Tuesday is in Jacksonville and they're in Puerto Rico on Friday. So they sail Tuesday around 5:00 to 6:00 at night they leave Jacksonville. So --

DR. RAPPAPORT: And this is what they have in front of them. It starts moving to the west/southwest or it's forecast to do that. So he -- I guess, by timing, when would he have expected to be in the vicinity of the central Bahamas?

MS. FINSTERBUSCH: Well, as it turns out, we don't know exactly when he lost power but it would have been sometime Thursday, right? Because -- I mean -- well, what do you have here for the ship -- the last -- the one before this, the next to last one. I mean those were good readings.

DR. RAPPAPORT: Okay. So he went pretty much on his course and speed until near the end, I guess.

MS. FINSTERBUSCH: Yes.

DR. RAPPAPORT: You said he shifted a little bit but -- so he was expecting then to be near the central Bahamas Wednesday evening and night it looks like because that's when he did arrive there.

MS. FINSTERBUSCH: Yes.

DR. RAPPAPORT: So the very first graphic shows what the forecast was for Wednesday, early afternoon and then for Thursday, early afternoon. So he was expecting to go through that area between these two times. But, you know, the storm and the forecast changed.

DR. KNABB: And one thing that the initial graphic obscures is what the probable track area would be at the 24 hours and what it would be at the 48 hours and so forth. But, because of the uncertainty in exactly where the storm would be and how intense and large it would be, that's why the marine hurricane warning, you know, was

issued for that large of an area.

MS. FINSTERBUSCH: Right. Right.

DR. RAPPAPORT: What we've been talking about here is where would the center of the storm be and what the side -- what would the extent of the wind -- of the seas be on a perfect forecast. But this white area is -- actually, as we said, encompasses where the storm historically will be two-thirds of the time. So it could actually be anywhere in here or in here. Two-thirds of the time and even one-third of the time it could be -- it would be -- it will go outside of this.

So that's where it was forecast to be but the risk area was much greater because the storm center could have been all the way down here. It could have been up in here.

MS. FINSTERBUSCH: Yes.

DR. RAPPAPORT: And, in fact, the seas could have been larger than forecast and turned out to be larger than was initially forecast and the winds turned out to be stronger. So the storm was -- wound up being stronger and a little -- and further south than was originally forecast but it looks like the forecast that was available when he left essentially covered that change anyway in that it was showing the 12-foot seas getting to the Bahamas and there was a -- then a marine hurricane warning up already at that

time. It became more extreme than was forecast.

DR. KNABB: There are -- as you might imagine, a large number of text and graphical products that our office issued during these time frames that we're not showing here.

MR. FURUKAWA: Yeah.

DR. KNABB: There's a large section of production that come out from TATH B. The hurricane specialist unit issues wind-speed-probability products that cover this entire area, so the chances of winds at tropical-storm force and hurricane force, incorporating the uncertainty in the track, intensity and size and so forth. So any of those products are available online in our archive or -- and/or we could provide whatever additional, you know, products that were issued during this time that would be useful.

MR. FURUKAWA: In the last graphic -- so, at 4:00 in the morning, he is experiencing 12 to 30-foot seas and winds of less than 64 knots.

DR. RAPPAPORT: Probably close to it because, remember, the storm was moving. It had two more hours of motion to the store after this analysis.

MR. FURUKAWA: Oh, okay.

DR. RAPPAPORT: So it would have been pretty close to the -- to hurricane-force winds at that time --

MR. FURUKAWA: Okay.

DR. RAPPAPORT: -- because it would have been a little closer to the ring there.

MR. FURUKAWA: And -- but, at 7:00, you know, we got back to that first -- what we first said when we came over here the Captain reported at 7:00.

MS. FINSTERBUSCH: Ten to twelve-foot swells.

MR. FURUKAWA: Ten to twelve-foot swells.

DR. RAPPAPORT: This was four hours later?

MR. FURUKAWA: Yeah.

MS. FINSTERBUSCH: This is when he's disabled.

MR. FURUKAWA: At 7:00 a.m. on the first?

MS. FINSTERBUSCH: Yeah.

MR. FURUKAWA: Yes. We're on the -- you know, at 4:00, he should have 3-foot seas.

DR. RAPPAPORT: Well --

MR. FURUKAWA: And a few hours later you're saying he's got --

DR. RAPPAPORT: Do we have the right day? I'm just curious because -- well, the last --

MS. FINSTERBUSCH: Yeah.

DR. RAPPAPORT: -- point we have is 4:00 -- is 3:56 a.m. So you have another point hours later?

MS. FINSTERBUSCH: Well, at 4:00 --

DR. RAPPAPORT: Another observation from the

call?

MS. FINSTERBUSCH: This is his -- on his phone call --

DR. RAPPAPORT: Okay.

MS. FINSTERBUSCH: -- he said -- I guess that's "swells northeast?"

MR. WEBB: Yep.

MS. FINSTERBUSCH: "Ten to foot" -- "twelve-foot swells, high winds." Yeah.

MR. WEBB: I mean he wasn't really that specific in how he put it but --

DR. RAPPAPORT: Is that 7:00 UTC or 7:00 eastern or what?

MR. WEBB: Eastern. Eastern time.

MR. WEBB: Maybe eastern?

MS. FINSTERBUSCH: Yeah.

MR. WEBB: So this -- is that -- I mean the time zone over here, is that a one-hour difference?

MS. FINSTERBUSCH: It's the same.

MR. WEBB: The same? I -- we heard the actual recording that he made when he left a message. He was extremely calm in his -- in his demeanor when he was talking, although -- I mean almost immediately after this we started getting -- the EPR went off, his -- he lit off his -- a couple other Inmarsats -- he -- alert and another

alert. So we start -- we got all these alerts not more than within a half an hour after he had -- he had made that phone call. And he -- they were never -- there was no contact with that ship again.

DR. RAPPAPORT: Well, if we were to extrapolate this four more hours, it would seem to be that the ship would be right near or in the eye wall.

MR. WEBB: Or in the eye.

DR. RAPPAPORT: Yeah, or in the eye wall, which is the worst right around the eye.

MR. WEBB: Even if you made it through one side, you have to make it through the other side, right, to get through it?

DR. RAPPAPORT: Yeah. If this is -- this is already a 120-mile-an-hour hurricane.

DR. KNABB: And the ocean doesn't go calm in the middle of an eye.

MR. WEBB: No?

DR. KNABB: It's mountainous.

MR. WEBB: It's just like -- it's just like a wash machine or -- I mean I --

MR. FURUKAWA: There's a mix.

MR. WEBB: Is it a -- yeah, I mean it -- because everything's kind of coming --

MS. FINSTERBUSCH: I mean you've got a ship

that's listing. You've got a ship that has no forward thrust at that point. At 7:00, we weren't moving anymore. He might have had lights. We don't know. And we don't know how long that was going on. We don't know whether it had been something that happened ten minutes earlier or two hours ago and they tried to start everything again and then realized they were stopped and cold?

DR. RAPPAPORT: So, at midnight -- at midnight, there was no indication of a problem?

MS. FINSTERBUSCH: At 4:00 in the morning, there was no indication of a problem.

DR. RAPPAPORT: Oh, it was 4:00.

MS. FINSTERBUSCH: Because that's when we got the email.

DR. RAPPAPORT: Just outside the eye wall there, so winds --

MR. WEBB: I mean, besides getting a forecast, if you're out there and it's dark out, would you know you were that close to the eye wall?

DR. RAPPAPORT: No.

(End of recording.)

(Begin audio

130213_0028DrRickKnabbDepDirDrEdRappaportNatHurCtr_Part 2)

MALE PARTICIPANT: I don't think so.

DR. KNABB: You wouldn't know necessarily you're that close to the most extreme conditions. But you would know you're in --

DR. RAPPAPORT: You're in a bad storm.

DR. KNABB: -- in some pretty bad conditions because even at 12:01 a.m. on Thursday, October 1, that position. You're going to be feeling the seas.

DR. RAPPAPORT: You know, we have, you heard from our hurricane hunter group that they had the planes out there. With this SMFR still frequency radiometer, we can see what was reported from the sea in terms of the winds.

MALE PARTICIPANT: Yes.

DR. RAPPAPORT: To the west of the center. I don't know when the most recent transit would have been through the center. But we can take a look for this particular pass of the aircraft when it, closest to this time, what the distribution of the winds were, how fast it dropped off at least based on that instrument.

DR. KNABB: And again, this depiction about 11:00 p.m. on the 30th, when the ship was in that approximate location west of the storm at 12:01 on the 1st, you know, that's our best depiction operationally of at least 12 foot seas.

DR. RAPPAPORT: I can go ask if somebody could

plot out the aircraft observations. If you give me a minute, I'll go ask them to plot the aircraft observations for this time.

MS. FINSTERBUSCH: The Captain, when he gave his latitude and longitude --

DR. KNABB: We can provide it after the fact.

MS. FINSTERBUSCH: At 7:00, just so you can see where the center is, his location was 23 26.3 and 73 51.6.

DR. KNABB: That's at what time?

MALE PARTICIPANT: Pretty close

MS. FINSTERBUSCH: At 7:00 in the morning.

DR. RAPPAPORT: Okay. So it was 23 degrees, 26 minutes? Or --

MS. FINSTERBUSCH: 26.3. I'm an engineer.

DR. KNABB: I don't know whether those are minutes. Those are probably minutes.

MALE PARTICIPANT: Minutes, yes.

DR. RAPPAPORT: 26 minutes.

MALE PARTICIPANT: 26.3 minutes.

DR. RAPPAPORT: Okay. And then 73 and 51 minutes. The storm is at -- and that was at what time?

MS. FINSTERBUSCH: That was at probably 06:59.

DR. RAPPAPORT: So that's about three hours after this.

DR. KNABB: That's 7:00 a.m. on the 1st?

MS. FINSTERBUSCH: Yes.

DR. KNABB: Okay. Well we had a public advisory at 8:00 a.m., an hour later.

MALE PARTICIPANT: Okay.

DR. KNABB: And the position that we had at 8:00 a.m. on Thursday, October 1st is 23.2, 73.7 for the center.

DR. RAPPAPORT: So if we do that, the ship was at 23.4 and a half. So that's like 15 miles north. And 51 minutes versus --

MALE PARTICIPANT: What was it, 73 --

DR. RAPPAPORT: Which is eight and a half.

MALE PARTICIPANT: 73.51

DR. RAPPAPORT: So that's another ten minutes to the west. That would have put him basically in the eye wall. Yes, in the northwestern eye wall.

DR. KNABB: Yes. And the max winds were 120 miles an hour.

MS. FINSTERBUSCH: At that point, he had no engine, no power.

DR. RAPPAPORT: And presumably about the highest seas. Although I don't know exactly --

DR. KNABB: Hard to know for sure because the seas and the winds can vary quite a bit even in the core.

DR. RAPPAPORT: So if it's of interest to you, we can find the plot of the winds.

MR. FURUKAWA: That would be -- yes.

DR. RAPPAPORT: Probably if the aircraft was estimating, the most recent one right afterwards, whenever it was closest.

DR. KNABB: One always has to be careful when you're looking at aircraft data to be certain you interpret what you're looking at. Because you can get flight level data, you can get drops on data, you can get surface wind speed estimates from the SFMR. So we have to be clear on what we're looking at.

DR. RAPPAPORT: I think the last of those is probably going to focus on the surface wind speed estimates.

MALE PARTICIPANT: So it gives the wind speed. Does it give direction or just the speed of the wind?

DR. RAPPAPORT: Just the speed.

MR. WEBB: And does it give height of waves also?

DR. RAPPAPORT: No.

MR. WEBB: No just --

MALE PARTICIPANT: But you can --

DR. RAPPAPORT: Do we have an altimeter pass?

DR. KNABB: I have no idea. Those altimeter passes are few and far between.

MALE PARTICIPANT: Okay.

DR. RAPPAPORT: There's some satellites that will give you an estimate of the height of the seas as they go over, over very narrow swaths that don't necessarily line up with where you're, your point of interest.

MALE PARTICIPANT: Like the, what do they call it? The SARs or --

DR. RAPPAPORT: Yes.

MR. FURUKAWA: You want to end the tape? Okay. At the end of an interview, we like to ask an open ended question. What do you think can be done to prevent, you know, something like this from happening again?

DR. KNABB: I guess I can make one general statement. That is, that part of our mission here at the Hurricane Center is not only to issue forecasts and warnings but to increase understanding of those hazards. And to do outreach and education to our partners, our users, the public.

We also continue to interact with our partners to determine what enhancements could be made in the future to our product and warning suite.

DR. RAPPAPORT: I guess, I'm trying to put myself in his shoes knowing what I know about weather and not knowing what he knows about being a captain of a ship. It looks like, if I was there and saw the forecast, at least with the uncertainty, I wonder whether the route that was

taken was the best.

The question that I would have then is, did he have this information? And if he did, was it understood completely by him?

DR. KNABB: And which of our products were they looking at? Because there is a large collection of graphics and text products.

DR. RAPPAPORT: Right. They're all consistent.

DR. KNABB: They're all consistent but there are a variety of formats. If the forecast comes from the hurricane specialist here but we have, our tropical analysis and forecast branch, TAFB, that puts out marine products and warnings specifically for marine users and partners. So we just don't know which of the products were being looked at.

MS. FINSTERBUSCH: Right.

DR. RAPPAPORT: I guess from our experience, knowing what was forecast, knowing the uncertainties --

DR. KNABB: Which is what drove what warnings we issued.

DR. RAPPAPORT: Right. There was a danger ahead. Again, as I said, I don't know what he knew of this or what he had of this information and what he understood of it and what he did with it.

MS. FINSTERBUSCH: He has down, per the latest BVS weather file, Bon Voyage Suite or something.

DR. RAPPAPORT: I'm not familiar with that.

MS. FINSTERBUSCH: And NWS Hurricane Center Miami, Florida.

MALE PARTICIPANT: I think Bon Voyage is a site. I don't know if it's a commercial one but they aggregate your data or something.

DR. RAPPAPORT: What day and time was that?

MS. FINSTERBUSCH: He sent me that -- well actually yes, he did send it to me. Wednesday, September 30th at 1:12.

DR. RAPPAPORT: That's 1:12 p.m.?

MS. FINSTERBUSCH: Yes. So he had actually, it sounds like this was his plan, his voyage plan. So he would have figured it out earlier in the day. And this is what he said was his voyage plan.

DR. RAPPAPORT: Right. Because this is almost three hours after the most recent advisory we issued which is this one on the graph at 11:00 a.m. that day. At 11:00 a.m. that day, the storm has 70 knots wind. We can look through this. Moving southwest at six. So somewhere he got a number that wasn't --

DR. KNABB: Yes. He had the intensity lower than our advisory.

DR. RAPPAPORT: Fifty miles per hour, 50 knots you said?

MS. FINSTERBUSCH: Yes. It was -- because you guys both jumped on that one.

DR. RAPPAPORT: It was a hurricane as opposed to a tropical storm and it was increasing. I guess that's the other --

DR. KNABB: And what we also don't know, at least I don't know at the moment, is was he aware of the marine hurricane warnings that he was entering around one?

DR. RAPPAPORT: And the distribution of the seas.

DR. KNABB: Yes.

MS. FINSTERBUSCH: It said winds 50 knots with gusts up to 70.

DR. RAPPAPORT: It hadn't been 50 knots since before he left. It was 55 knots when he left.

MS. FINSTERBUSCH: And seas 12 to 14 foot throughout the night and in tomorrow morning.

DR. RAPPAPORT: No. See here's the forecast. The most recent one was 12 to 28. And then let's see, if we go back to the previous one, it was 12 to 27. It sounds like the information he had was dated. Twelve to 26 before that. When he left, it was actually 12 to 24 from the forecast. I wonder if it wasn't dated information. You

said the most recent but I don't know what that would have been, what did he receive?

DR. KNABB: So to answer your question one more time is we'd want to know for future benefit how -- in this case they were receiving the various products and warnings from us. Which ones were they receiving? Did they get them in a timely manner? Were they the right ones that were valid at the time? How were they getting them? If they didn't, what prevented that and so forth.

DR. RAPPAPORT: And if he did, obviously he's well trained, he's been doing this for many years. But was there some misunderstanding of what was being forecast? But it sounds like, if that's potentially a key point, that the information he had might have been old.

Because indeed, when he left, just before that was the first forecast for it to become a hurricane. Before that, it was forecast to be a tropical storm. And if that's the case, the winds -- I can go back and look but it would have been forecast to have 12 foot seas but not 24, raging up to 24, 27, 30 feet.

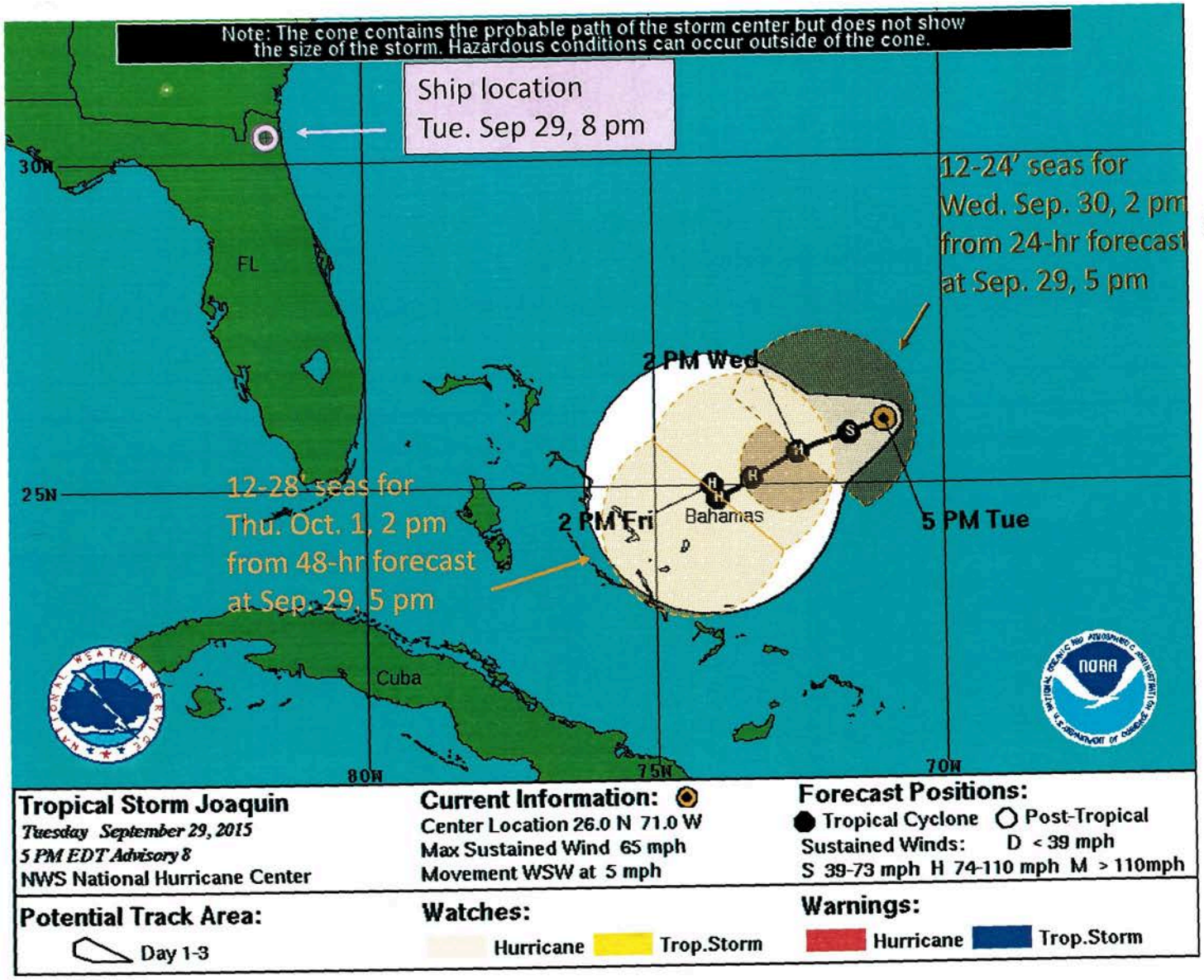
MR. FURUKAWA: Well thank you very much. Time is 15:36 on the 14th of October, Wednesday. And we're ending the interview with Dr. Knabb and Dr. Rappaport.

(Whereupon, the above-entitled matter went off the record at 3:36 p.m.)

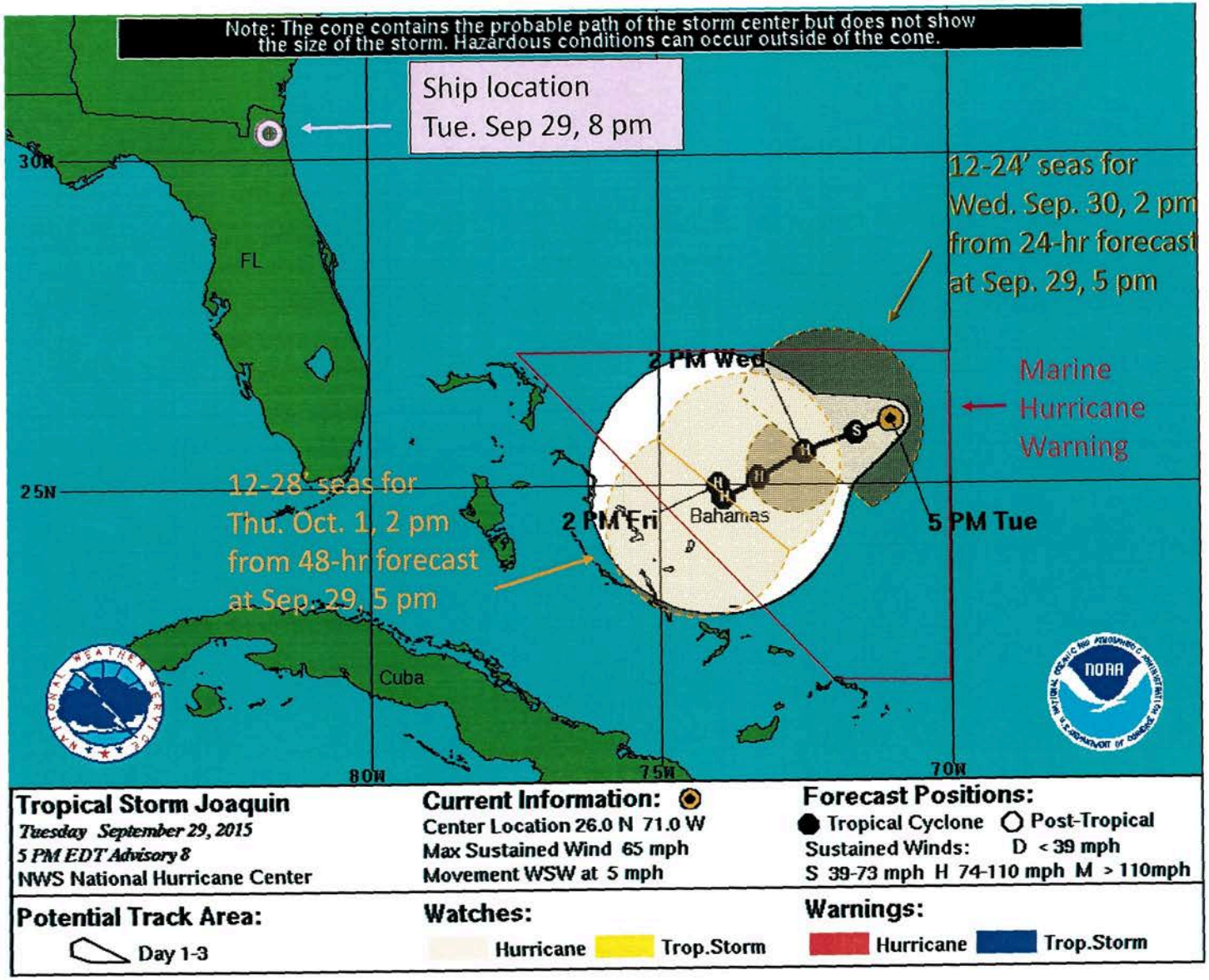
ROUGH (Hand) ANALYSIS OF NHC PRODUCTS
AND
CONCURRENT EL FARO LOCATION*

draft developed by
Ed Rappaport (NHC)
October 14, 2015

*Ship location and radii of seas and winds approximated

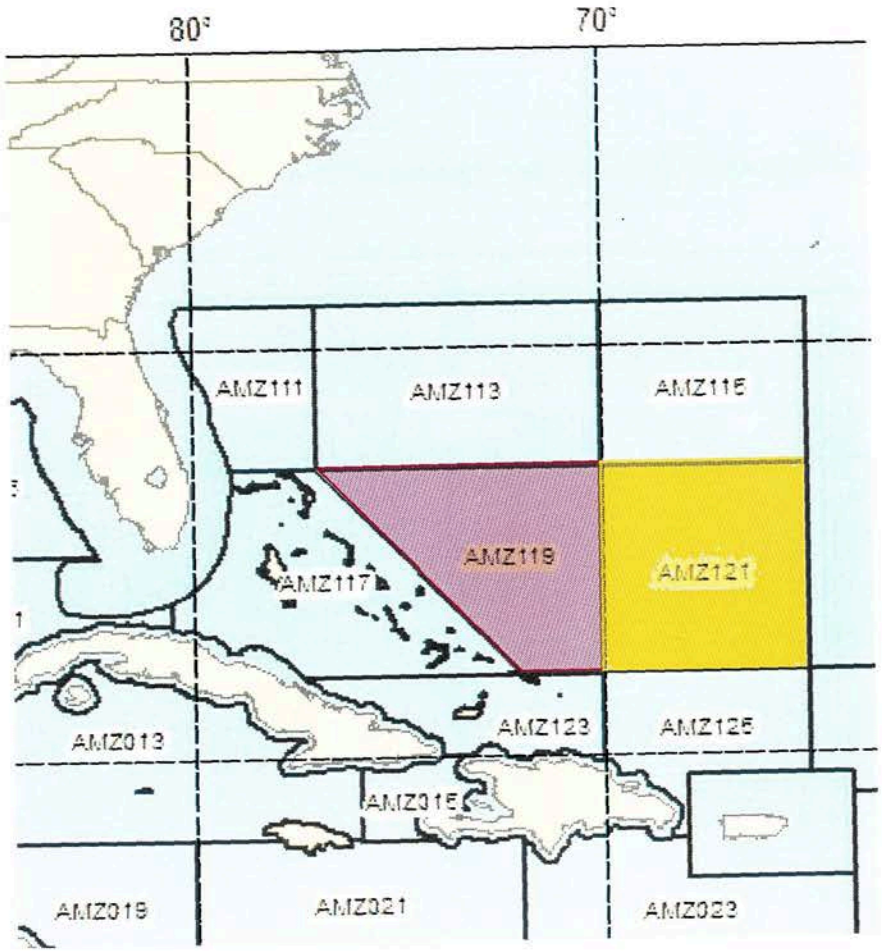


Ship location and 12' sea radii approximated



Ship location, warning area and 12' sea radii approximated

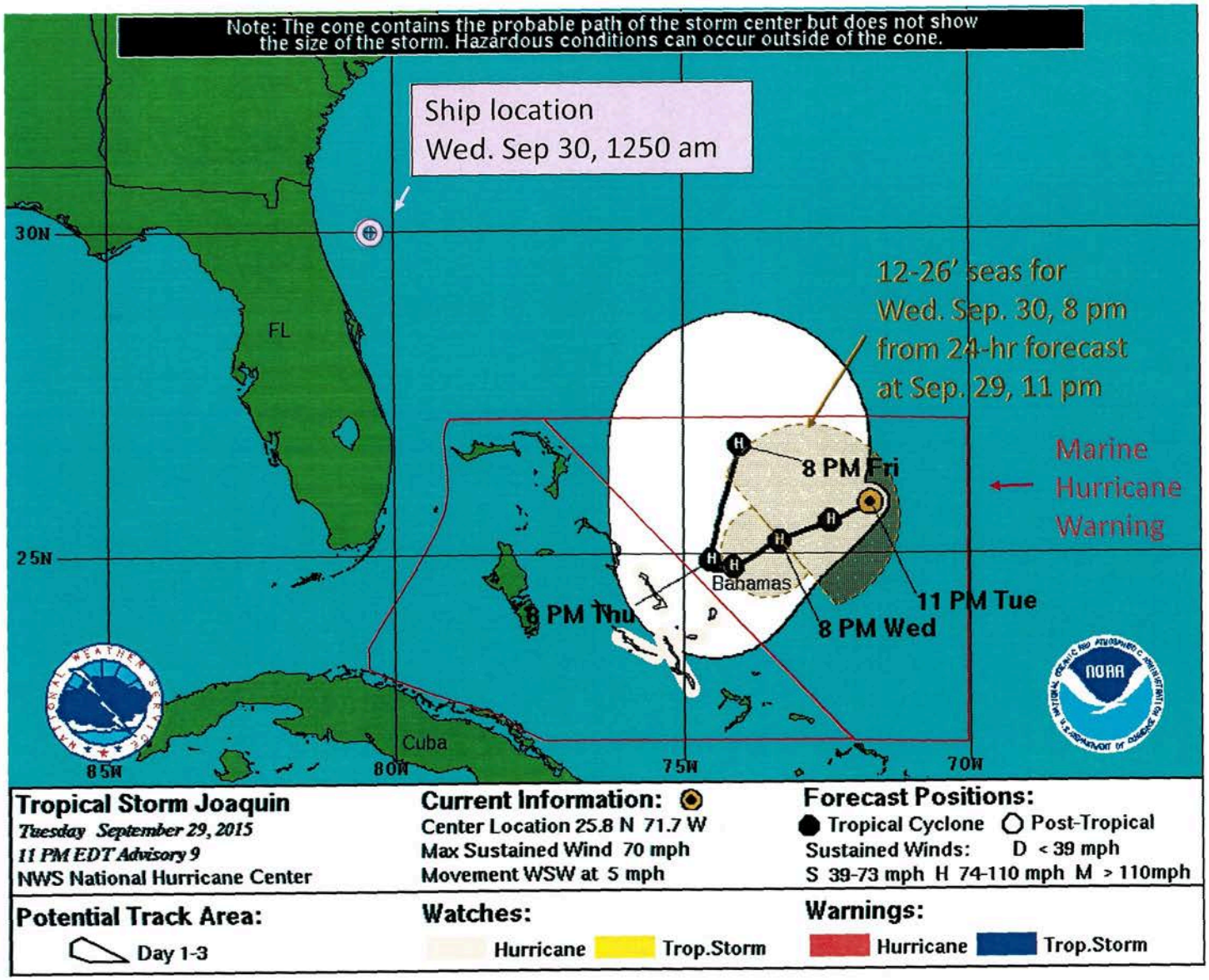
Offshore Zones



Valid Tue. Sep. 29, 8 pm

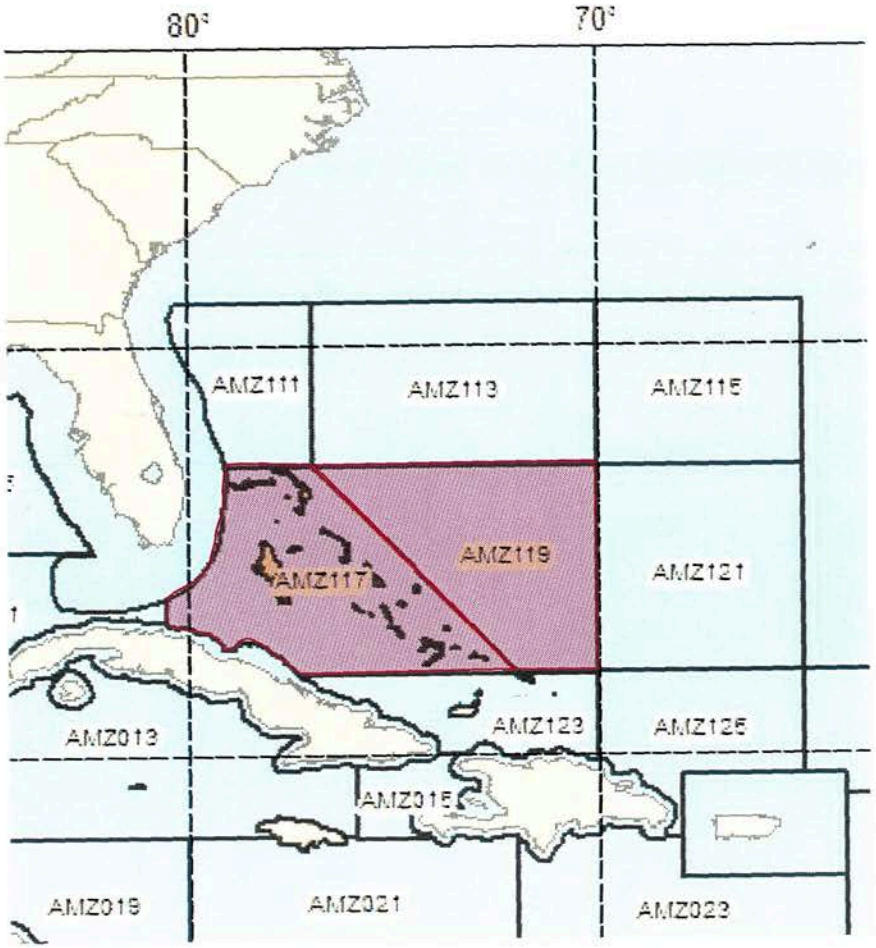
Hurricane Warning

Tropical Storm Warning



Ship location, warning area and 12' sea radii approximated

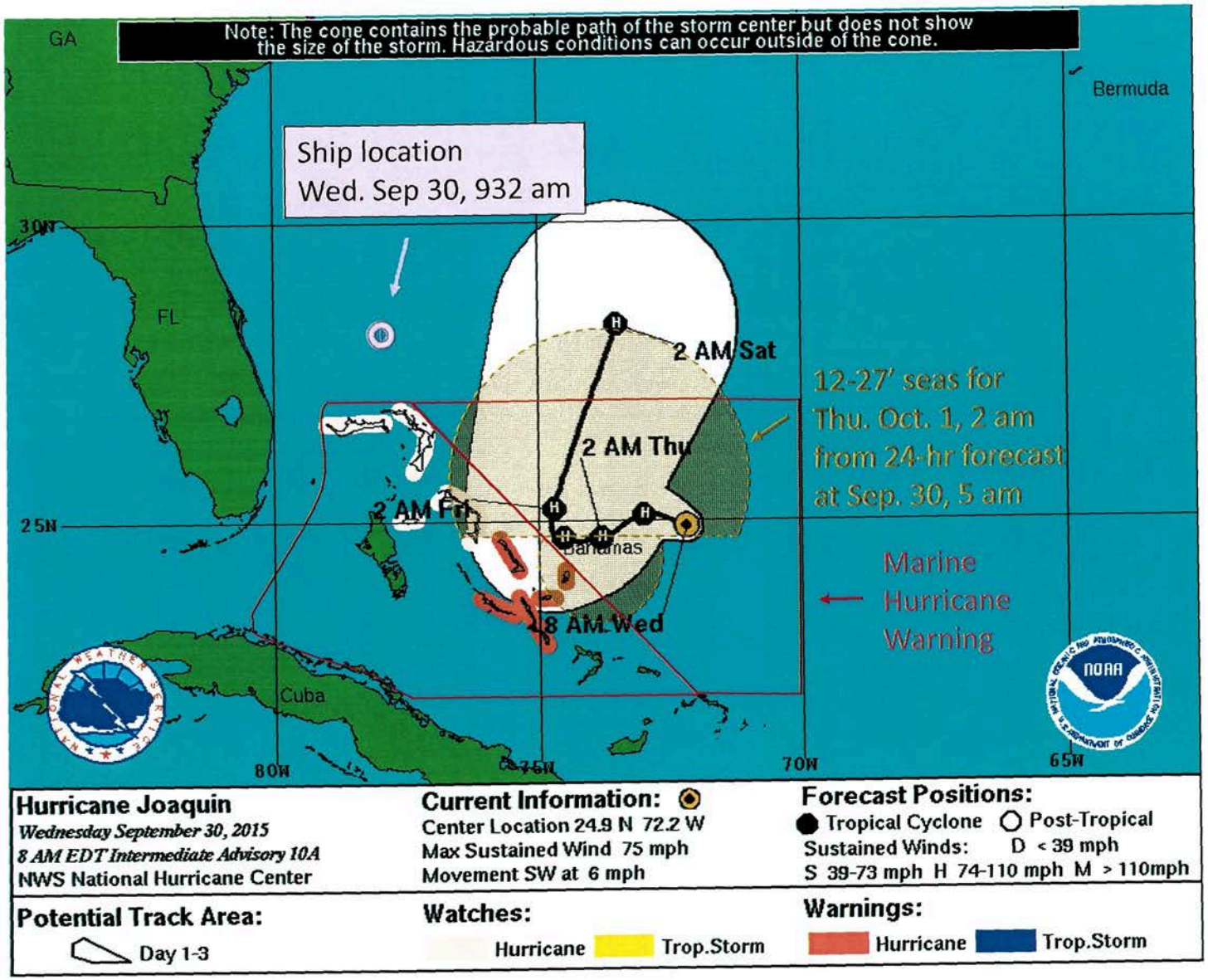
Offshore Zones



Valid Wed. Sep. 30, 1250 am

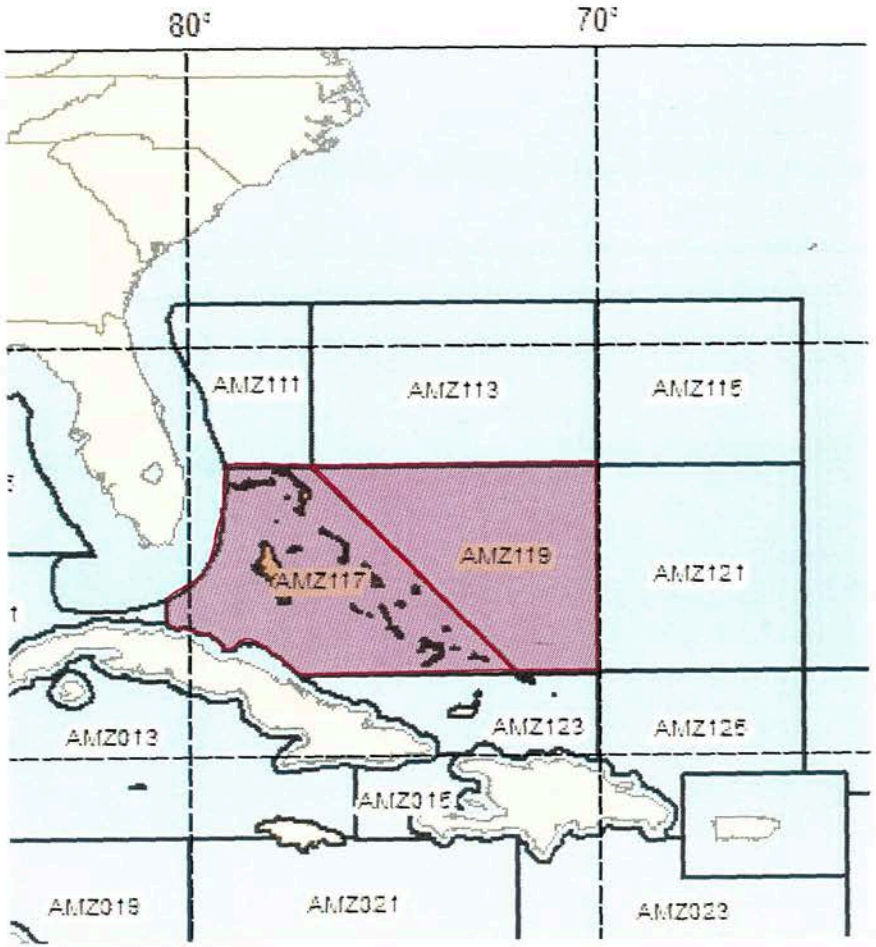
Hurricane Warning

Tropical Storm Warning



Ship location,
warning area
and
12' sea radii
approximated

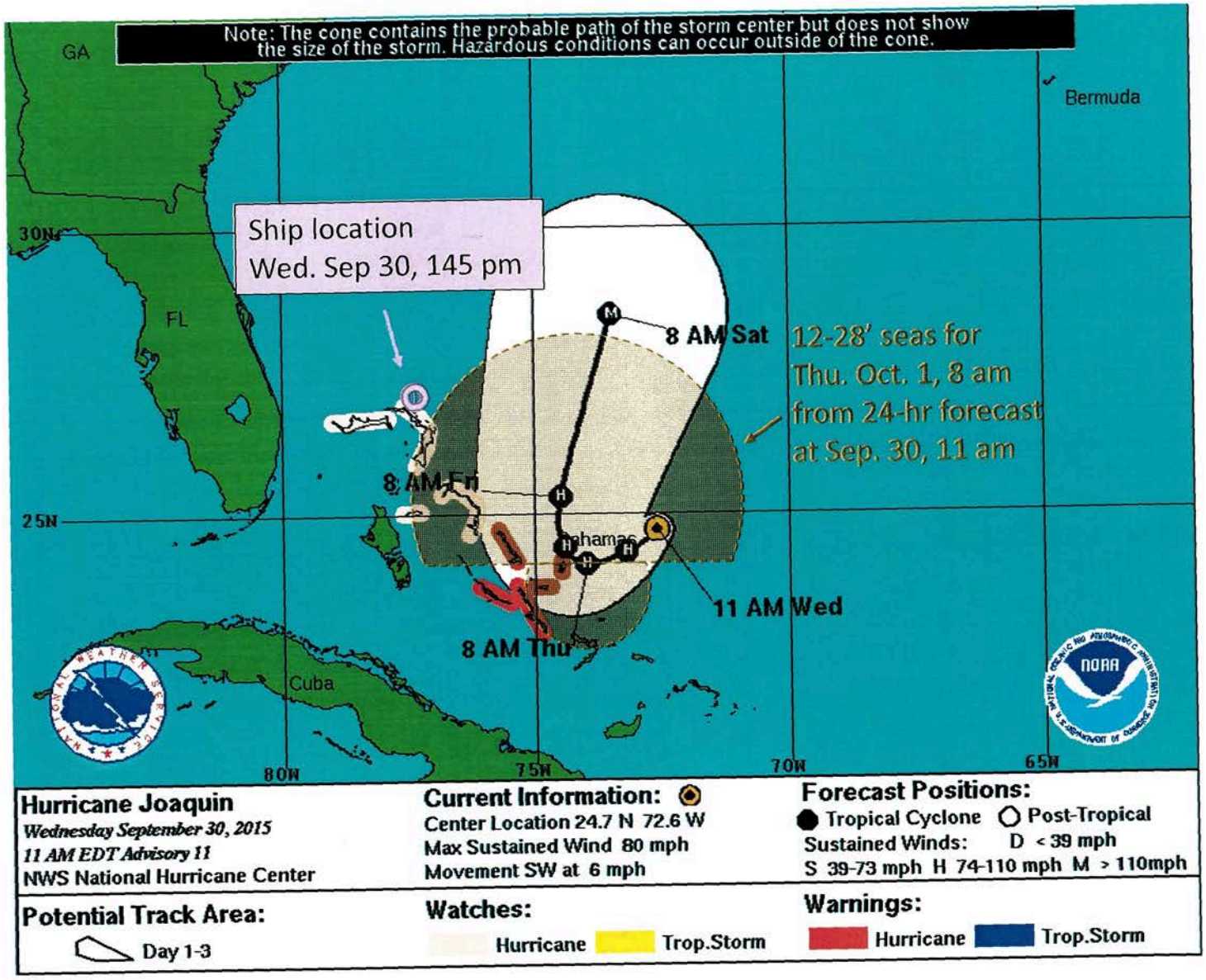
Offshore Zones



Valid Wed. Sep. 30, 932 am

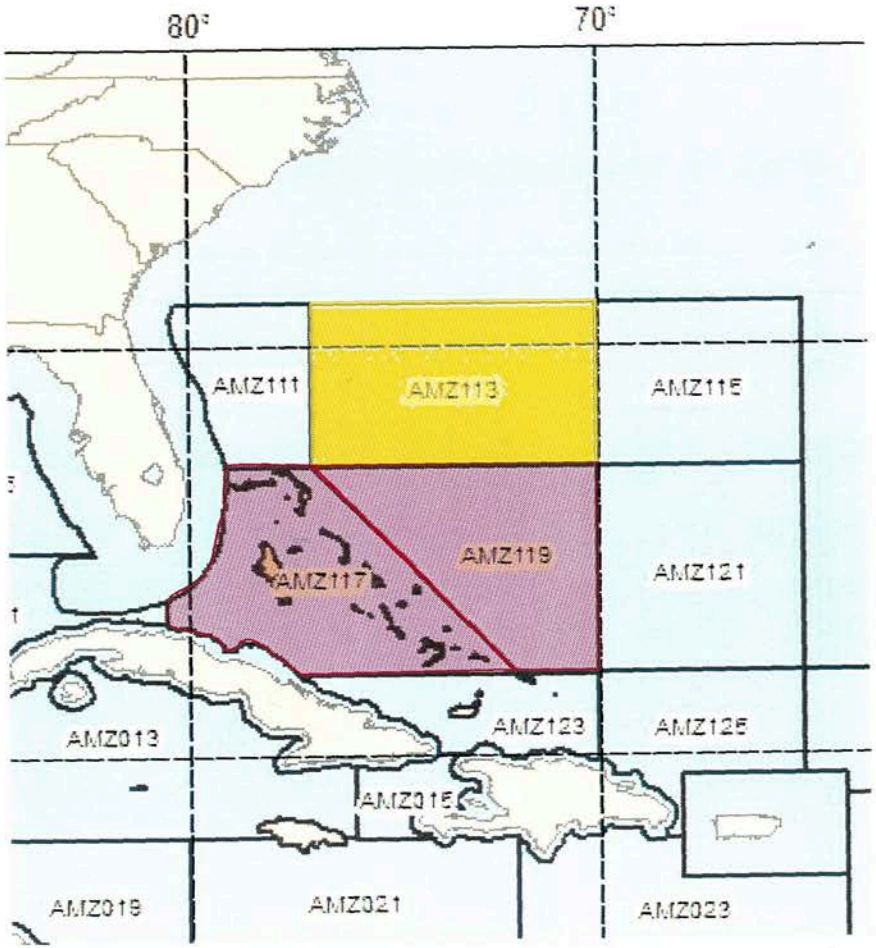
Hurricane Warning

Tropical Storm Warning



Ship location and 12' sea radii approximated

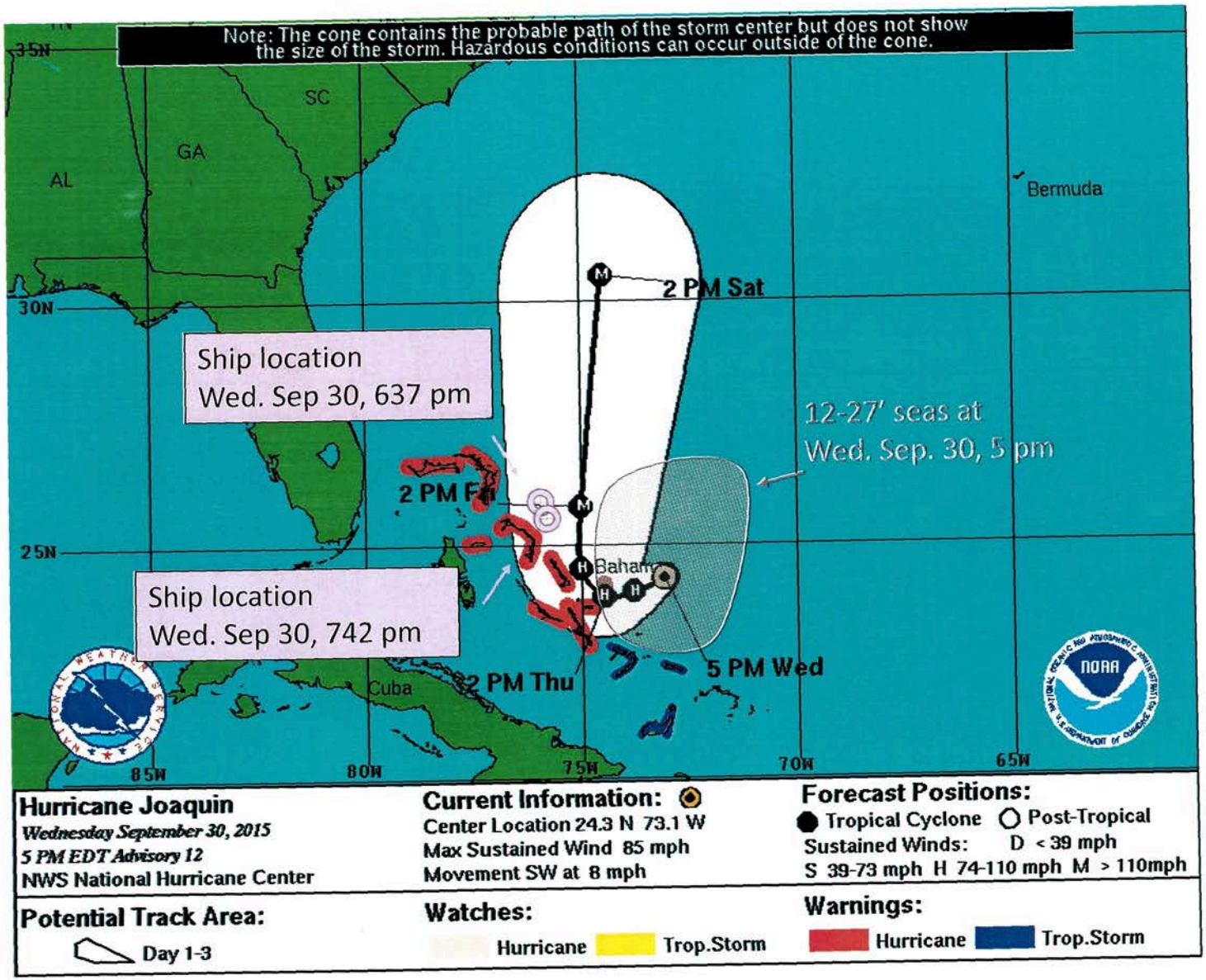
Offshore Zones



Valid Wed. Sep. 30, 145 pm

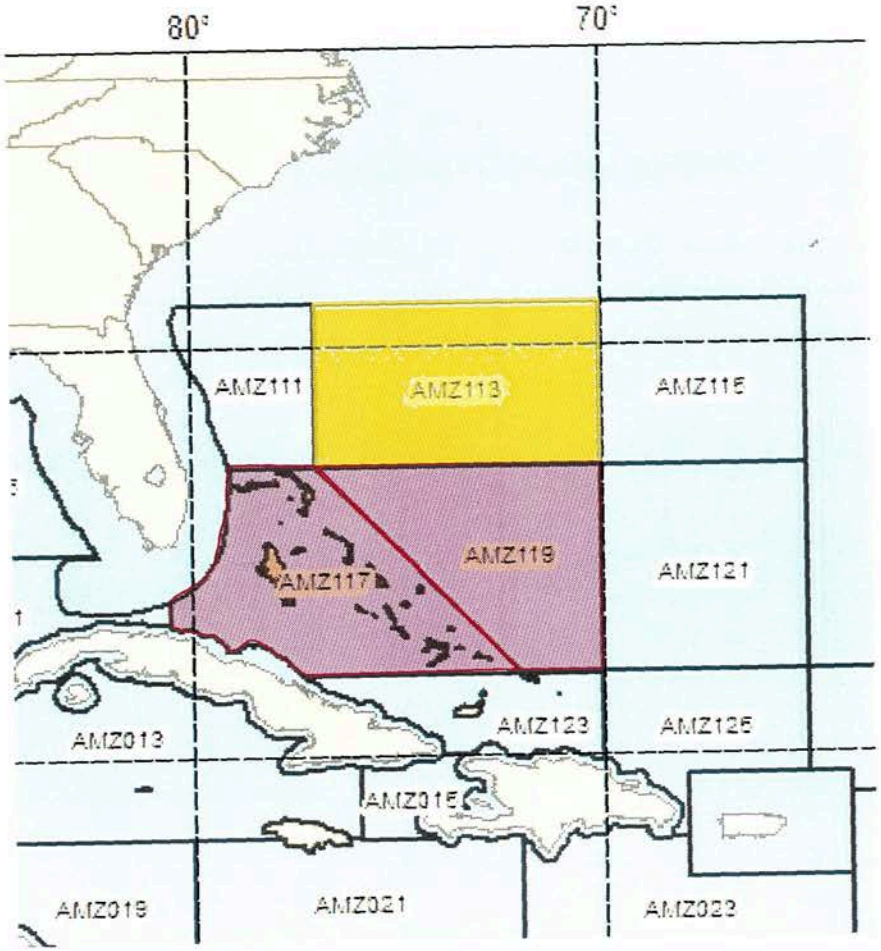
Hurricane Warning

Tropical Storm Warning



Ship location and 12' sea radii approximated

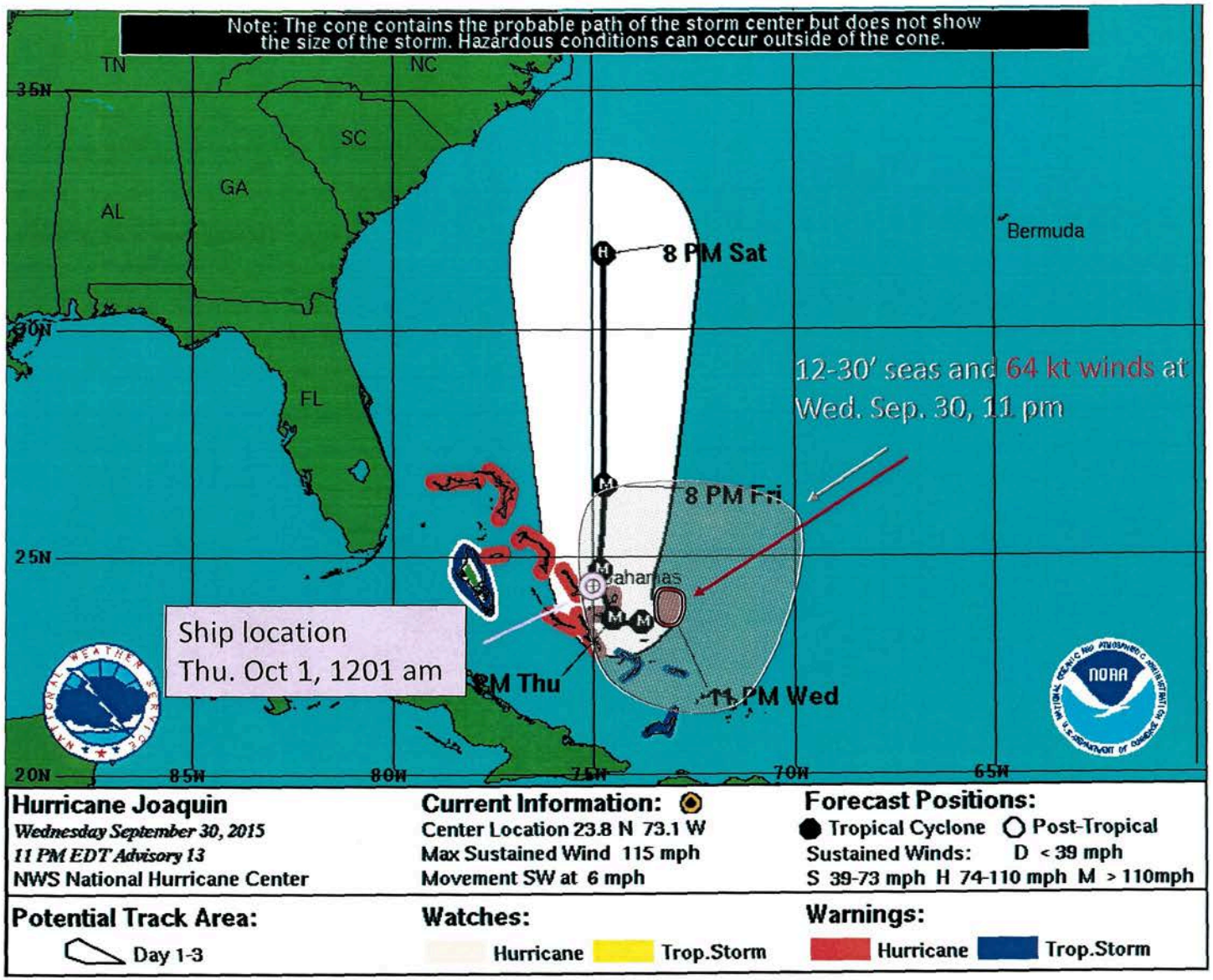
Offshore Zones



Valid Wed. Sep. 30, 637 pm

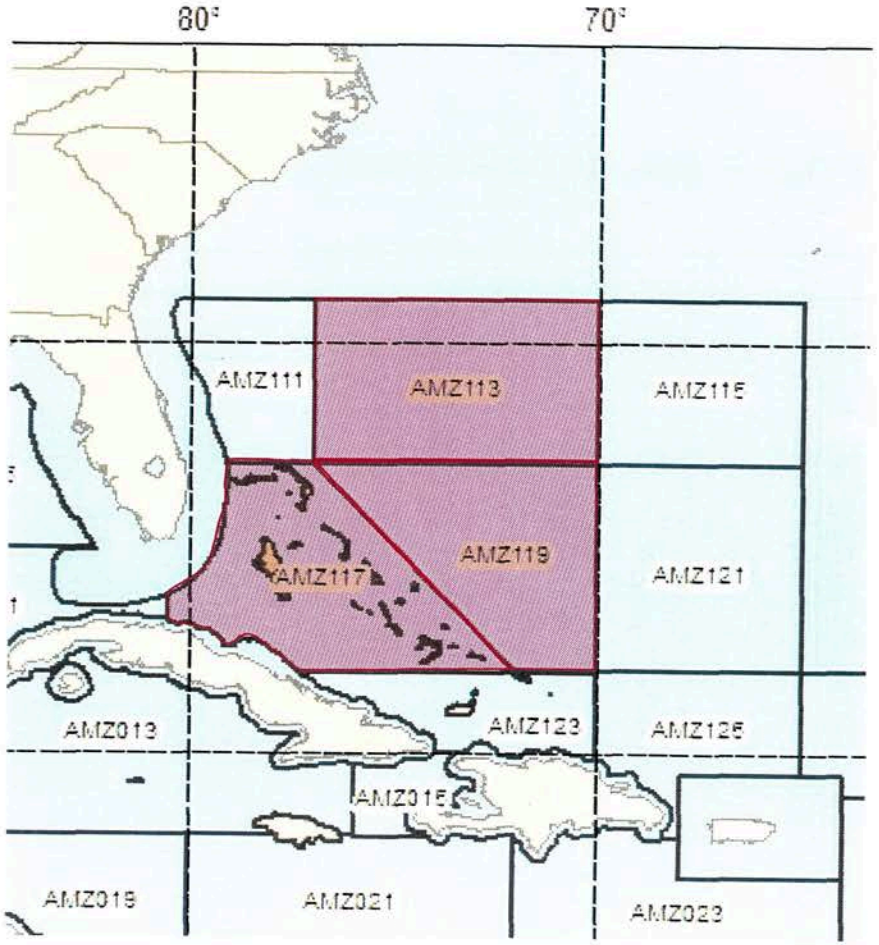
Hurricane Warning

Tropical Storm Warning



Ship location, 12' sea and 64 kt wind radii approximated

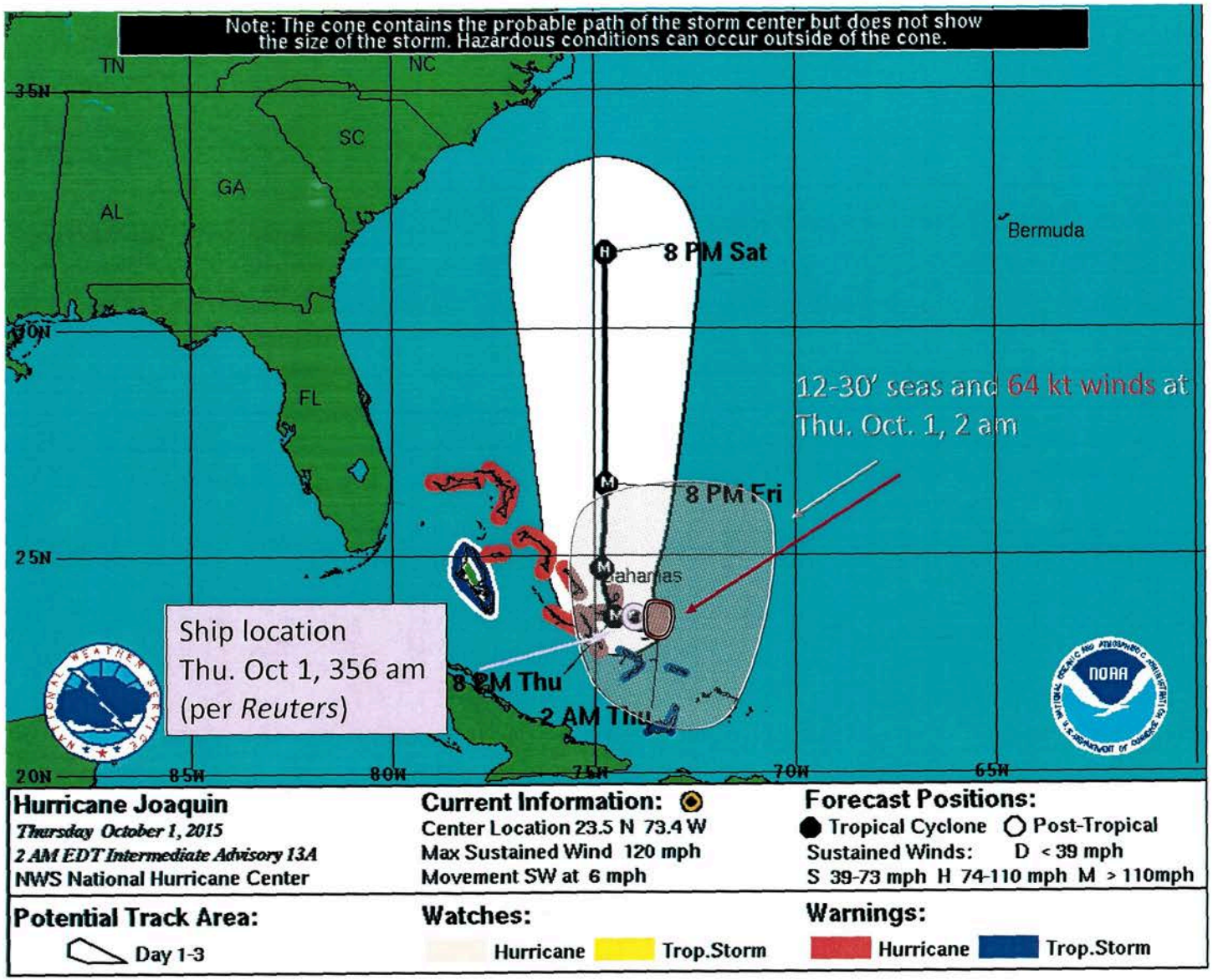
Offshore Zones



Valid Thu. Oct. 1, 1201 am

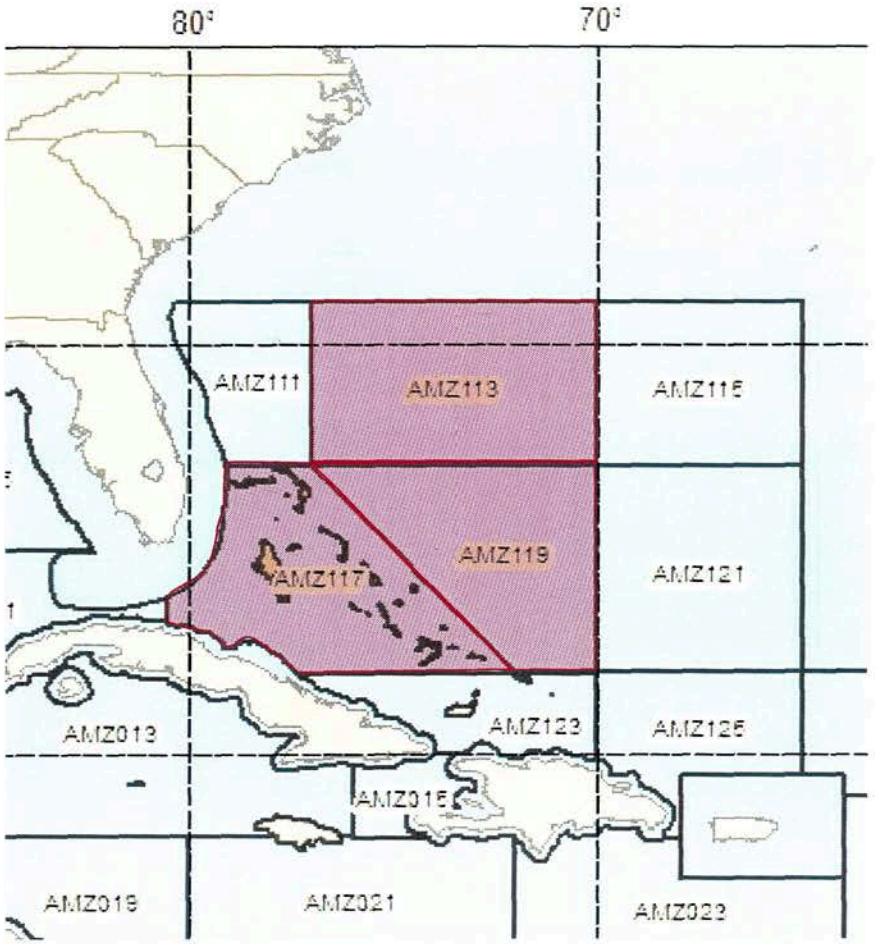
Hurricane Warning

Tropical Storm Warning



Ship location, 12' sea and 64 kt wind radii approximated

Offshore Zones



Valid Thu. Oct. 1, 356 am

Hurricane Warning

Tropical Storm Warning